

Preservation of Fruit Products by Sodium Sorbate and Mild Heat^a

James F. Robinson and
Claude H. Hills

Eastern Regional Research Laboratory,^b
Philadelphia 18, Pennsylvania

SORBIC ACID has been used to preserve a variety of food products. Recent investigations by Salunkhe (5), Ferguson and Powrie (2), and Weaver, Robinson and Hills (6), have shown that sorbic acid or sodium sorbate was effective for inhibiting yeast fermentation in unpasteurized apple juice (cider). Spoilage was usually due to the inability of sorbate to control bacterial growth.

The minimum conditions for pasteurization of apple juice were studied by Cruess, Aref, and Irish (1). They found that all cells in apple juice were killed in ten minutes at 134° F. Other investigators report somewhat higher temperatures as being required. Pederson and Beavens (4) found that when the juice attained 154° F. (fourteen minutes come-up time) all microorganisms had been destroyed. More recently Marshall and Walkley (3) using inocula of isolated apple juice microorganisms found that a holding time of five or ten minutes at 145° F. (including a 20 minute come-up time) was required for sterilization. All of these heat treatments are considerably in excess of the conditions used in this study.

The present study is an investigation of the preservation of apple juice, peach slices, and fruit salad (pineapple and citrus slices) subjected to temperatures of 100° F. to 130° F. for five minutes in the presence of sodium sorbate. Fruit products stabilized in this manner could be stored for several weeks at room temperature with little change in flavor.

MATERIALS AND METHODS

Sodium sorbate was used throughout this study in place of sorbic acid because of the difficulty of dissolving the latter in cold fruit juices. The sodium sorbate solution was prepared from a purified grade of sorbic acid by neutralizing to pH 8 with sodium hydroxide, and adjusting to 25% concentration.

Cider samples were obtained from a local cider mill. The freshly pressed cider was pumped into a 500-gallon tank located in a refrigerated room held at 40° F. Cider samples were taken from the tank immediately after it was filled; and then sufficient Pectinol 5B and sodium sorbate were added with stirring to give final concentrations of 0.2 pound per 100 gallons and 0.06% respectively. The treated cider was allowed to settle in the cold room for 48 hours and then the supernatant liquid was decanted and heated to 120° F. in a heat exchanger. The heated material was put into bottles, which were then capped, and allowed to cool in air. Samples for plate counts, flavor evaluation, and storage tests were taken just

prior to and after heating. The above experiment was repeated on five different batches of cider.

Fruit salad was prepared in the laboratory from fresh fruit purchased from a local food market. The oranges, grapefruit, and pineapples were peeled and cut into small pieces, covered with dry sugar (10% by weight) and the mixture allowed to stand in the refrigerator for 48 hours. Then the juice was removed from the solids. A concentration of 0.12% of sodium sorbate by weight was added to the juice, giving a final concentration of 0.048% based on net contents of juice and solids. This experiment was repeated at a later date and similar results were obtained.

The sections were placed in wide-mouthed containers and the juice proportioned out between them. The filled containers were heated to 120° F. for 5 minutes, capped, and cooled in a water bath.

The peach slices were also prepared in the laboratory, using fully matured fruit of 2 varieties, Newday and Jubilee. Skins were removed by immersing the fruit in boiling water for one minute and then slipping off the skins. The pits were removed and the peaches cut into ¼ inch slices. Twelve ounces of slices were put into each container along with 4 ounces of a 60° Brix syrup. Sufficient sodium sorbate was added to the containers to give a final concentration of 0.12% by weight on the basis of 16 ounces net contents. The prepared samples were heated, capped, and cooled in a water bath. Enough peach slices were prepared from each variety to provide 4 jars for each experimental treatment.

Nutrient agar was used to determine the number of bacteria in the different samples and "Difco" wort agar to determine the number of yeasts and molds. The numbers reported in the tables are the average number of cells found on duplicate plates which had been incubated at 86° F. for 72 hours.

The flavor of the cider was evaluated by a 10-member laboratory taste panel at each plating date. The treated material was compared with fresh, untreated, frozen cider from the same pressing. The standard "Triangle Test" was the method used for the flavor evaluations.

RESULTS AND DISCUSSION

The number of microorganisms encountered in commercially prepared fruit products will vary widely depending upon the sanitary conditions of the plant, the condition and type of raw material, and the season of the year. The microbial counts of the materials used in these experiments are thought to be fairly representative for these products. In the first experiment, the cider contained 460,000 yeasts and molds and 520,000 bacteria immediately after pressing. Table 1 shows the plate counts that were obtained after the sorbate and Pectinol had been added and the cider allowed to settle for 48 hours. It is interesting to note the difference obtained in the plate counts of the cider immediately after pressing and those obtained after it had settled for 48 hours. This decrease is thought to be due chiefly to the inhibitory effect of the sodium sorbate in the juice, although it

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^b Eastern Utilization Research and Development Division, Agricultural Research Service, United States Department of Agriculture.

TABLE 1
Effect of mild heat and sodium sorbate on apple cider stored at 73° F.

Treatment	Days storage	Cells per ml. ¹		Remarks
		Wort	Nutrient	
Sodium sorbate ²	0	135,000	175,000	Good flavor
	5	250,000	210,000	Good flavor
	9	.....	.....	Gas formation
Heat alone ³	0	22,000	27,000	Good
	6	.....	34,000	Fair
	12	.....	.....	Gas formation
Sodium sorbate plus heat ³	0	1,550	2,200	Good flavor
	5	1,000	1,100	Good flavor
	23	.....	.....	Gas formation

¹ Starting material contained 460,000 yeasts and molds and 520,000 bacteria.

² 0.06% sodium sorbate added.

³ 120° F. for 5 minutes.

is possible that part of this decrease was due to sedimentation.

The overall storage life of cider preserved by sorbate and mild heat was increased nearly threefold over cider treated with sorbate alone. And the increase was over 10-fold when comparing it with the completely untreated cider stored at room temperatures. Similar results were obtained with the other batches of cider.

Table 2 shows the effect of sodium sorbate and various heating temperatures on cider stored at room temperature. As the heating temperature was increased the microbial counts on both the wort and nutrient agar decreased. At a heating temperature of 130° F. for 5 minutes, the storage life of the cider was increased to 29 days when stored at room temperature. This is to be compared with an 8-day storage life of the cider treated with only sodium sorbate, and a 15-day storage life when cider was treated with heat only.

Taste panel evaluation of these samples showed that there were no appreciable differences between the different heat treatments. Tests between the heat treated cider and the original material, which was preserved by freezing, also showed little or no differences.

TABLE 2
Effect of various heat treatments and sodium sorbate on cider stored at 73° F.

Treatment	Days storage	Cells per ml. ¹		Remarks
		Wort	Nutrient	
Sodium sorbate ²	0	340,000	440,000	Good flavor
	5	155,000	325,000	Good flavor
	8	.....	.....	Gas formation
Sodium sorbate plus 100° F. ³	0	230,000	250,000	Good flavor
	5	14,000	55,000	Good flavor
	12	.....	.....	Gas formation
Sodium sorbate plus 120° F. ³	0	1,100	4,000	Good flavor
	5	600	750	Good flavor
	23	.....	.....	Gas formation
Sodium sorbate plus 130° F. ³	0	0	600	Good flavor
	5	1,050	1,800	Good flavor
	29	.....	.....	Gas formation
Heat to 130° F. only	0	850	3,000	Good
	5	650	1,750	Good
	15	.....	.....	Gas

¹ Starting material contained 690,000 yeasts and molds and 800,000 bacteria.

² 0.06% sodium sorbate added.

³ Heated for 5 minutes.

Citrus fruit salad that was treated with mild heat and sodium sorbate showed no microbial spoilage after 90 days' storage at room temperature. Table 3 shows the results obtained from this experiment. The salad that had no treatment showed profuse gas formation after only 2 days' storage at room temperature. That treated with sodium sorbate alone spoiled in 11 days when stored at room temperature.

TABLE 3
Effect of mild heat and sodium sorbate on fruit salad stored at 73° F.

Treatment	Days storage	Cells per ml.		Remarks
		Wort	Nutrient	
Control	2	6,200,000	15,000	Gas formation
Sodium sorbate ¹	11	.....	.....	Gas formation
Sodium sorbate ¹ plus heat ²	90	2	5	Good flavor

¹ 0.048% sodium sorbate added to the juice based on net contents.

² 120° F. for 5 minutes.

In all of the heat treated samples, the top ½ inch of fruit had an oxidized appearance. This reaction is thought to be due to the presence of oxygen in the sealed container. When this oxidized material was removed, the flavor of the remaining salad was satisfactory.

Microbial spoilage was prevented for more than 92 days when fresh peach slices were treated with sodium sorbate and mild heat and stored at room temperature, as shown in Table 4. One treatment spoiled in 21 days due to mold growth on top of the product.

TABLE 4
Effect of mild heat and sodium sorbate on the storage life of peach slices

Treatment	Days to gas formation		
73° F. storage	0.06% ¹	3	0.12% ¹
Control (no treatment).....			
100° F. for 15 min.....	92		92
110° F. for 10 min.....	21 ²		92
120° F. for 5 min.....	92		92 ³
50° F. storage		12	
Control (no treatment).....			
100° F. for 15 min.....	92		92
110° F. for 10 min.....	92		92
120° F. for 5 min.....	92		92

¹ Sodium sorbate.

² All samples showed mold growth.

³ One sample had mold growth (on top of contents).

All of the samples at both storage temperatures had at least a ½ inch of oxidized fruit at the top. After removing this oxidized portion, the remaining material had good flavor, texture, and color.

SUMMARY

A combination of sodium sorbate (0.06 to 0.12%) and mild heat (120° F. for five minutes) greatly increased the storage life of fresh apple cider, peach slices, and fruit salad. In the presence of 0.06% sodium sorbate, a heat treatment as mild as 100° F. for five minutes destroyed more than 50% of the initial yeasts, molds, and bacteria in cider and increased the storage life to 14 days at room temperature. At 120° F. there was a 99% reduction in microbial counts and the storage life was increased

to 23 days at 70° F. Similar results were obtained with peach slices and fruit salad.

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